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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1722	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/069,031	KAEPPELER ET AL.	
	Examiner	Art Unit	
	Matthew J. Song	1722	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 June 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *40-66* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *40-66* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2/14/02*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Withdrawn Rejections

1. Applicant's arguments, see page 12 of the remarks, filed 6/13/2006, with respect to the 35 USC 103 rejection over claims 40-45 have been fully considered and are persuasive. The rejection of claims 40-45 has been withdrawn. Wengert et al does not teach heating a substrate by heating the walls of a chamber of the reactor.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claim 46, 47, 50-51, 54, 56, and 60-63 are rejected under 35 U.S.C. 102(b) as being anticipated by Wengert et al (WO 97/06288A1).

In an apparatus for chemical vapor deposition of semiconductor wafers, note entire reference, Wengert et al discloses a reaction chamber **130** with a plurality of radiant heat lamps are arranged around the reaction chamber to heat a susceptor **134** and a wafer **144** (pg 15, ln 15-36), this reads on applicant's heating on all sides of the reactor. Wengert et al also discloses a gas injector **156** is positioned upstream of a process chamber **130** and includes a plurality of reactant gases flow horizontally **112** (pg 16, ln 10-35 and Fig 8), this reads on applicant's at least one process or carrier gas is introduced just ahead of the substrate. Wengert et al also disclose a

plurality of heat lamps heat the susceptor (pg 15, ln 25-35), this reads on applicant's holder is actively heated during the heating of the substrate. Wengert et al discloses a gas injector **156** includes water cooling channels and intended to maintain the temperature of the material for the gas injector at approximately 60°F or cooler (pg 23, ln 1-30), this reads on applicant's actively cooled gas inlet.

Referring to claim 46, Wengert teaches a heated reactor (Fig 27), this reads on applicant's actively heated flow channel, a rotatable susceptor (Abstract), an inlet **374** just ahead of the susceptor (Fig 27), an outlet (Fig 28a), a horizontal flow(Fig 27), a heater **378a, 378b**. Wengert also teaches thermocouples **102** to sense temperature, which allows comprehensive feedback regarding temperature and enables adjustment of the radiant heating lamps surrounding the chamber, this reads on applicant's temperature control device. Wengert discloses cooling channels within a gas injector, this reads on applicant's coolable gas inlet. The radiant heating lamps are capable of performing the claimed intended use of heating to 1100-1800°C.

Referring to claim 47, Wengert discloses a rotationally symmetrically inlet and outlet (Fig 28a).

Referring to claim 50, Wengert discloses a rotatable susceptor. (Abstract).

Referring to claim 51, the limitations further limit only the intended use of the temperature controller. The apparatus taught by Wengert et al is capable of performing the claimed intended use; therefore reads on the claim.

Referring to claim 54, Wengert discloses quartz and graphite, this reads on applicant's highly conductive material.

Referring to claim 56, Wengert discloses a liquid medium.

Referring to claims 60-61, Wengert discloses a boundary wall which is capable of being cooled.

Referring to claim 62, Wengert discloses two substrates.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 49 and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wengert et al (WO 97/06288 A1), as applied to claims 46, 47, 50-51, 54, 56, and 60-63 above, and further in view of Burk (US 5,788,777).

Wengert et al teaches all of the limitations of claim 49, as discussed previously, except Wengert et al does not teach a turning deice for rotation of the substrate by gas foil rotation.

Burk teaches a modified susceptor for epitaxial growth reactors for growing silicon carbide epitaxial layers. The susceptor assembly has multiple substrate holders which are levitated and rotated by an inert gas flow (Abstract), this clearly suggests applicant's gas foil rotation. Burk also teaches the susceptor is made of graphite, SiC or SiC coated graphite (col 4, ln 10-12).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Wengert et al using the susceptor taught by Burk because substrate holders which are levitated and rotated by an inert gas flow which avoid cracking problems associated with high temperature growths ('777 col 3, ln 10-65).

Referring to claim 57, the combination of Wengert et al and Burk does not teach an adapter piece as claimed. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Wengert et al and Burk by using an adapter piece, as claimed, to control flow.

6. Claims 48, 55, 58-59, and 64-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wengert et al (WO 97/06288 A1) as applied to claims 46, 47, 50-51, 54, 56, and 60-63 above, and further in view of Flynn et al (US 6,447,604).

Wengert et al discloses all of the limitations of claim 48, as discussed previously, except the substrate holder having a continuous inert coating such as TaC or NbC.

Flynn et al discloses a method of reducing defects and thereby improving the quality of epitaxial layers formed in a reactor by vapor phase epitaxy (i.e. CVD). Process conditions include temperatures of from 500-1250°C and pressure from 1-1000 torr. Materials grown

include AlN and GaN (abstract). Flynn et al also discloses TaC and NbC inert coating are made on the susceptor and reactor parts. (col 7, ln 50-60).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Wengert et al by coating the susceptor and reactor with TaC or NbC to help reduce defects present in GaN.

Referring to claims 58-59, It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Wengert et al and Flynn et al by using different inert materials in the outlet segments and on the substrate holder because at least two inert materials were known (TaC and NbC) and described as alternatives. Those of ordinary skill in the art would have expected different materials to have different properties.

Referring to claim 63, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the prior art by using graphite because graphite is a well known material of construction which efficiently transfers heat, which is desirable.

7. Claims 53 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wengert et al (WO 97/06288 A1) as applied to claims 46, 47, 50-51, 54, 56, and 60-63 above, and further in view of Hirata et al (US 4,542,273).

Wengert et al discloses all of the limitations of claim 53, as discussed previously, except the boundary wall heating by two separate circuits.

Hirata et al discloses heating with multiple circuits. (col 1, ln 1-67).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Wengert et al by using two circuits for induction heating for independent control and because it is less costly (col 1, ln 10-25).

8. Claim 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wengert et al (WO 97/06288 A1) as applied to claims 46, 47, 50-51, 54, 56, and 60-63 above, and further in view of Crawley et al (US 5,871,586).

Wengert et al discloses all of the limitations of claim 52, as discussed previously, except a combination of high frequency, lamp and resistance heating means.

In an apparatus for MOCVD, note entire reference, Crawley et al teaches heating systems which include induction heating, radiation heating or resistance heating as desired. (Col 3, ln 40-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Wengert by using a combination of known heating means, as taught by Crawley et al, because a combination of known equivalents is held to be obvious. (MPEP 2144.06).

9. Claims 40-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kordina et al (US 5,792,257) in view of Burk (US 5,788,777) and Crawley et al (US 5,871,586).

In a method of epitaxially growing SiC or Group III nitride, note entire reference, Kordina et al teaches heating susceptor walls surrounding a channel **1** for heating a substrate **2** and a precursor within the channel, this clearly suggests applicant's actively heated flow channel reactor and heating is accomplished by an elevated temperature of heated walls of a chamber of

the reactor on all sides of the reactor chamber. (col 4, ln 55-67). Kordina et al also teaches heating the substrate to a temperature of 1500-1700°C (col 5, ln 15-35), this clearly suggests applicant's heating to a temperature of 1100-1800°C. Kordina et al also teaches a susceptor and a SiC plate **5** for holding the substrate **2** (Fig 2). Kordina et al teaches process gases enter through an inlet **3** and flow horizontally through the reactor containing a substrate **2** (Fig 1, Fig 2 and col 5, ln 1-15), this clearly suggests applicant's process gas is introduced just ahead of the hot substrate and flows in a horizontal direction past the substrate. Kordina et al teaches epitaxially forming SiC, this clearly suggests heteroepitaxial or homoepitaxial deposition.

Kordina et al does not teach the substrate rotates in the heated flow channel reactor.

Burk teaches a modified susceptor for epitaxial growth reactors for growing silicon carbide epitaxial layers. The susceptor assembly has multiple substrate holders which are levitated and rotated by an inert gas flow (Abstract), this clearly suggests applicant's gas foil rotation. Burk also teaches the susceptor is made of graphite, SiC or SiC coated graphite (col 4, ln 10-12).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Wengert et al by rotating the substrate, as taught by Burk, because substrates which are levitated and rotated by an inert gas flow avoid cracking problems associated with high temperature growths ('777 col 3, ln 10-65) and because substrate rotation is used to average out non-uniformities in the heating and gas flow patterns.

The combination of Kordina et al and Burk does not teach the process or carrier gases are actively cooled to a temperature well below a process temperature that is present within the reactor.

In a method of chemical vapor deposition, note entire reference, Crawley et al teaches first and second precursors of the material to be deposited are cooled prior to entry into the reaction chamber (Abstract). Crawley et al also teaches a means for cooling conduits connecting the precursors to the reaction chamber (col 2, ln 1-45 and col 4, ln 55-67), this clearly suggests applicant's actively cooling the process gas before being introduced into the reactor.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kordina et al and Burk by using the cooled conduits for introducing process gases to a reactor, as taught by Crawley et al, to prevent premature reaction of the process gases and provide good mixing of the gases (col 1, ln 50-67).

Referring to claim 41, the combination of Kordina et al, Burk and Crawley et al teaches substrate holders which are levitated and rotated by an inert gas flow which avoid cracking problems ('777 abstract and col 3, ln 10-25), this clearly suggests applicant's gas foil rotation.

Referring to claim 42, the combination of Kordina et al, Burk and Crawley et al teaches silane and propane. ('320 col 5, ln 1-40).

Referring to claim 43, the combination of Kordina et al, Burk and Crawley et al teaches the susceptor is designed to obtain a substantially uniform temperature ('320 col 2, ln 50-60). The combination of Kordina et al, Burk and Crawley et al is silent to the complete decomposition of the source gases produces growth rates of 10 mμ/h or more on account of a homogeneous temperature profile. The combination of Kordina et al, Burk and Crawley et al teaches a uniform temperature is achieved, as applicant; therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of

Kordina et al, Burk and Crawley et al by increasing the growth rate to 10 mμ/h or more to improve productivity.

Referring to claim 44, the combination of Kordina et al, Burk and Crawley et al is silent to the reduction of Si clusters and seed formation is achieved by low temperature gradients perpendicular to the substrate. The combination of Kordina et al, Burk and Crawley et al teaches a uniform temperature is obtained within the susceptor; therefore the reduction of Si cluster and seed formation is expected to occur because the combination of Kordina et al, Burk and Crawley et al teaches a similar small gradients, as applicant.

Referring to claim 45, the combination of Kordina et al, Burk and Crawley et al is silent to the pressure of the process. However, pressure is well known in the art to be a result effective variable and the pressure claimed in within the known range of pressure conventionally used for CVD, as evidenced by Peters et al (US 6,097,039), note column 6, ln 45-65; therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kordina et al, Burk and Crawley et al by optimizing the pressure to obtain the claimed pressure by conducting routine experimentation.

Response to Arguments

10. Applicant's arguments with respect to claims 40-45 have been considered but are moot in view of the new ground(s) of rejection.

11. Applicant's arguments filed 6/13/2006 have been fully considered but they are not persuasive.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., actively heated flow chamber is provided by hot walls of the reaction chamber) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Claim 46 does not require heating on all side of a reaction chamber. Claim 46 merely requires an actively heated flow channel reactor chamber. Wengert et al clearly discloses a plurality of lamps are arranged around a reaction chamber to heat a susceptor and wafer within the chamber. (pg 15, ln 25-36). The chamber is actively heated by the lamps; therefore meets the claimed limitation.

Applicant's argument that Wengert et al does not teach a cooling device for actively cooling a process gas is noted but is not found persuasive. Applicant alleges that the gas injector with cooling channels taught by Wengert is used to cool the chamber, note page 13 of the remarks. Claim 46 merely requires a gas inlet that is actively cooled to a temperature which is well below the process temperature within the reactor chamber. Wengert et al clearly teaches the cooling flow through the passages is intended to maintain the temperature of the gas injector at approximately 60°F or cooler, where the use of cooling water reads on applicant's actively cooled. (pg 23, ln 10-25).

In response to applicant's argument that Wengert does not teach an actively cooled gas inlet for cooling the reaction gasses before entry into the reactor chamber, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior

art. If the prior art structure is capable of performing the intended use, then it meets the claim. Wengert et al discloses a gas inlet maintained at 60°F, which is below the process temperature of SiC deposition. The inlet taught by Wengert et al is capable of the claimed intended use; therefore meets the claimed limitation.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Nordell et al (US 5,759,263) teaches rotating a substrate about its axis during chemical vapor deposition to average out non-uniformities in the heating field and the gas flow pattern (col 2, ln 20-45).

Peters et al (US 6,097,039) teaches an epitaxial CVD method of SiC usually takes place at 1400-1800°C and 10,000-100000 Pa (100-1000 mbar), note column 6, lines 45-65.

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Yogendra Gupta can be reached on 571-272-1316. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1722

MJS
August 10, 2006